(A) Lesson Context

BIG PICTURE of this UNIT:	• How do we analyze and then work with a data set that shows both increase and decrease • What is a parabola and what key features do they have that makes them useful in modeling applications • How do I use graphs, data tables and algebra to analyze quadratic equations?

(B) Lesson Objectives:

a. Understand the connection between standard form of a quadratic function and the axes of symmetry of a parabola
b. Understand the connection between the vertex form of a quadratic function and the zeroes of a parabola
c. Understand the connection between expanding the product of binomial factors to the factorization of trinomials

(C) Opening Exercise: HW Skills Review

From Nelson 10, Chap 5.3

11. Write the equation of a parabola that matches each description.

a) The graph of $y = x^2$ is reflected about the x-axis and then translated 5 units up.

b) The graph of $y = x^2$ is stretched vertically by a factor of 5 and then translated 2 units left.

c) The graph of $y = x^2$ is compressed vertically by a factor of $\frac{1}{5}$ and then translated 6 units down.

d) The graph of $y = x^2$ is reflected about the x-axis, stretched vertically by a factor of 6, translated 3 units right, and translated 4 units up.

From Nelson 10, Chap 3.5

9. For a school experiment, Nichola recorded the height of a model rocket during its flight. The motion detector stopped working, however, during her experiment. The following data were collected before the malfunction.

Time (s)	0.0	1.0	2.0	3.0	4.0
Height (m)	2.00	19.5	27.0	24.5	12.0

a) The height–time relation is quadratic. Determine an equation for the height–time relation.

b) Use the equation you determined for part a) to estimate the height of the rocket at 3.8 s.

c) Determine the maximum height of the rocket. When did the rocket reach its maximum height?

(D) Finding the vertex from Standard Form:

EQN	axis of symmetry	EQN:	axis of symmetry
$y = x^2 + 4x - 12$		$y = x^2 + 4x + 3$	
$y = x^2 - 5x + 6$		$y = x^2 + 4x - 12$	
$y = x^2 - 5x$		$y = 2x^2 + 4x - 12$	
$y = x^2 + 12x$		$y = 4x^2 + 4x - 12$	
$y = x^2 + 3x - 8$		$y = 8x^2 + 4x - 12$	
$y = x^2 + 8x + 16$		$y = 16x^2 + 4x - 12$	

(E) Determining the Zeroes:

a. From Vertex Form: Find the zeroes of the following parabolas:

i. $y = (x-4)^2 - 1$
ii. $y = 2(x+1)^2 - 18$
iii. $y = -(x+5)^2 + 1$
iv. $y = -3(x+3)^2 + 75$
v. $y = (x-4)^2 - 10$
vi. $y = 2(x+1)^2 - 24$
vii. $y = -(x+5)^2 - 1$

b. From Standard Form (HINT: Let's find the vertex first ……. for now …..)

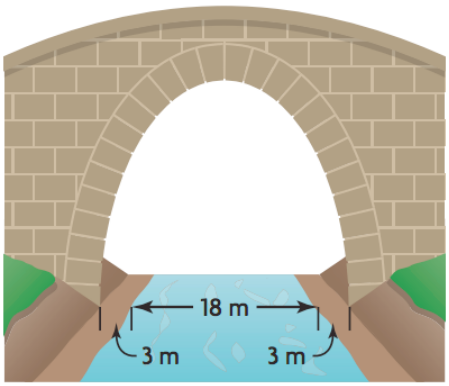
i. $y = 2x^2 - 12x$
ii. $y = -3x^2 + 12x$
iii. $y = 2x^2 + 4x - 6$
iv. $y = 2x^2 + 12x - 32$

(F) *Problem Solving: Zeroes & Vertex?*

a. The graph of $y = -2(x+5)^2 + 8$ is translated so that its new zeroes are -4 and 2. Determine:

i. The translation applied to the original graph
ii. The equation of the new parabola in standard form.

b. A bridge is going to be constructed over a river. The underside of the bridge will form a parabolic arch, as shown in the picture. The river is 18 m wide and re arch will be anchored on the ground, 3 m back from the riverbank on both sides. The maximum height of the arch must be between 22 m and 26 m above the surface of the river. Create two different models (equations) to represent the arches that satisfy these conditions.



(G) Algebra Review & Preview: Distributing and "un"distributing

a. Use the distributive property to find the product (multiply).

i. $4(x+2)$
ii. $-3(2x^2+1)$
iii. $6(x^2+2x+7)$
iv. $4x(1-x)$
v. $-x^2(x+5)$
vi. $3x^2\left(4x^3-5x+10\right)$
vii. $3x\left(-x^2+2x-12\right)$

b. Use division and the distributive property to simplify. Divide EVERY term.

i. $\dfrac{-15x+10}{5}$ ii. $\dfrac{6x^2+10}{2}$ iii. $\dfrac{-18x^2+21x}{-3}$

iv. $\dfrac{14x^3+28x^2-70}{7}$ v. $\dfrac{20x^4+15x^2}{5x^2}$ vi. $\dfrac{x^4+3x^3+7x}{x}$

c. "Un"distribute the following (called Factoring ➔ i.e. factor the following expressions)

1) $2a+2b$ 2) $5x^2+5$ 3) $18c-27d$ 4) $hb+hc$

5) $6x-18$ 6) $3a^2-9$ 7) $4x^2-4y^2$ 8) $p+prt$

9) $10x-15x^3$ 10) $2x-4x^3$ 11) $8x-12$ 12) $8-4y$

13) $3ab^2-6a^2b$ 14) $10xy-15x^2y^2$ 15) $21r^3s^2-14r^2s$ 16) $2x^2+8x+4$

17) $6c^3d-12c^2d^2+3cd$ 18) $3x^2-6x-30$ 19) $ay-4aw-12a$

20) c^3-c^2+2c 21) $2ma+4mb+2mc$ 22) $9ab^2-6ab-3a$

23) $15x^3y^3z^3-5xyz$ 24) $24x^{11}+4x^{10}-6x^9+2x^8$

25) $26x^4y-39x^3y^2+52x^2y^3-13xy^4$ 26) $16x^5+12xy-9y^5$

d. Use the **Distribution Property** to simplify the following:

i. $(x - 3)(x + 4)$
ii. $(2x + 4)(2x + 3)$
iii. $(x - 7)(x - 6)$
iv. $(3x - 1)(x + 5)$
v. $(4x + 3)(2x + 4)$
vi. $(x - 4)(x - 2)$

e. "Un"distribute each trinomial into two binomials and check using Distribution:

1) $a^2 + 3a + 2$	2) $c^2 + 6c + 5$	3) $x^2 + 8x + 7$	4) $r^2 + 12r + 11$
5) $m^2 + 5m + 4$	6) $y^2 + 12y + 35$	7) $x^2 + 11x + 24$	8) $a^2 + 11a + 18$
9) $16 + 17c + c^2$	10) $x^2 + 2x + 1$	11) $z^2 + 10z + 25$	12) $a^2 - 8a + 7$
13) $a^2 - 6a + 5$	14) $x^2 - 5x + 6$	15) $x^2 - 11x + 10$	16) $y^2 - 6y + 8$
17) $15 - 8y + y^2$	18) $x^2 - 10x + 24$	19) $c^2 - 14c + 40$	20) $x^2 - 16x + 48$
21) $x^2 - 14x + 49$	22) $x^2 - x - 2$	23) $x^2 - 6x - 7$	24) $y^2 + 4y - 5$
25) $z^2 - 12z - 13$	26) $c^2 - 2c - 15$	27) $c^2 + 2c - 35$	28) $x^2 - 7x - 18$
29) $z^2 + 9z - 36$	30) $x^2 - 13x - 48$	31) $x^2 - 16x + 64$	32) $x^2 - 11x - 42$
33) $x^2 - 9$	34) $x^2 - 36$	35) $x^2 - 121$	36) $64x^2 - 81$
37) $9x^2 - 25$	38) $144x^2 - 49$	39) $x^2 - 225$	40) $x^2 + 100$
41) $x^2 - 44$	42) $x^2 - x - 9$	43) $x^2 - 8x + 17$	44) $x^2 + 64$